
Coordinating PRI parameters

This chapter describes the major parameters that must be coordinated with the far end facility. These parameters are:

- Frame format
 - Superframe format
 - Extended superframe format
- Line encoding
 - B7 coding
 - B8ZS coding
- Error detection
 - Yellow alarm (remote alarm)
 - Bit error rate
 - Frame alignment
 - Frame slip
- Data rate parameters
 - 56 kbps inverted
 - 64 kbps clear and restricted
- Channel parameters
 - B-channels
 - D-channels
- Interface protocols
 - User to network
 - Symmetric

Frame format

The DS-1 basic format consists of 24 8-bit bytes with one byte per channel and one framing bit, or F-bit. This makes a total of 193 bits per frame. The nominal bit rate of the DS-1 signal is 1.544 Mbps and the sampling rate for each channel is 8000 Hz.

Superframe format

A superframe format, the standard format, consists of 12 DS-1 frames (see Table 1). It is consistent with the channel bank formats D2, D3, and D4. The signaling bit is time-shared to identify both the channel and the signaling frame. The framing pattern is the repeated sequence 100011011100.

Channel framing identifies the location of timeslot 1. The signaling frame identifies those frames in which two signaling states, A and B, are transmitted on a time-shared basis. The assignments of the F-bit and the A and B bits in the superframe format are shown in Table 1.

Table 1
The superframe format table

Frame number	F-Bit		PCM coding bits	Signaling bit	Signal channel
	Terminal framing	Signaling framing			
1	1	—	1–8		
2	—	0	1–8		
3	0	—	1–8		
4	—	0	1–8		
5	1	—	1–8		
6	—	1	1–7	8	A
7	0	—	1–8		
8	—	1	1–8		
9	1	—	1–8		
10	—	1	1–8		
11	0	—	1–8		
12	—	0	1–7	8	B
Note: The most significant bit is defined as bit 1 and the least significant bit as bit 8.					

Extended superframe format

The Extended superframe format (ESF) consists of 24 frames. The 8 kbps F-bit channel is divided into three separate channels:

- Framing Pattern Sequence (FPS)—Beginning with frame 4 or ESF bit 579, the framing bit of every fourth frame forms FPS 001011, which is used to determine the mainframe, superframe, and robbed bit signaling synchronization. This sequence is a 2 kbps channel.
- Facility Data Link (FDL)—This is a 4 Kbps channel, used to turn on a yellow alarm. Meridian 1 system software uses FDL to convey yellow alarm (remote alarm) information or to transmit all 1s, as selected in service change.
- Cyclic Redundancy Check (CRC)—The CRC sequence is a 2 kbps channel. CRC indicates one or more bit errors in a block, or bits from the received bit stream. CRC can be used as an end-to-end bit error rate indicator.

The assignments of the F-bit and the A, B, C, and D bits in ESF are shown in Table 2.

Table 2
Extended superframe format table (Part 1 of 2)

Frame number	F-Bit				Robbed bit signaling
	Bit number	Assignments			
		FPS	FDL	CRC	
1	0	—	m	—	A
2	193	—	—	CB1	
3	386	—	m	—	
4	579	0	—	—	
5	772	—	m	—	
6	965	—	—	CB2	
7	1158	—	m	—	
8	1351	0	—	—	
9	1544	—	m	—	
10	1737	—	—	CB3	
11	1930	—	m	—	B
12	2123	1	—	—	
13	2316	—	m	—	
14	2509	—	—	CB4	

Table 2
Extended superframe format table (Part 2 of 2)

Frame number	F-Bit				Robbed bit signaling
	Bit number	Assignments			
		FPS	FDL	CRC	
15	2702	—	m	—	C
16	2895	0	—	—	
17	3088	—	m	—	
18	3281	—	—	CB5	
19	3474	—	m	—	
20	3667	1	—	—	
21	3860	—	m	—	D
22	4053	—	—	CB6	
23	4246	—	m	—	
24	4439	1	—	—	

Line encoding

Line coding for DS-1 is bipolar, Alternate Mark Inversion (AMI). The general requirements for DS-1 code suppression are:

- a maximum of 15 consecutive zero binary bits
- a minimum average of 12.5 percent density of one binary bit over any 192 consecutive bits

To meet the maximum and minimum requirements, PRI provides B7 and B8ZS zero code substitution techniques as options.

B7 coding

B7 coding restricts the D-channel operating modes to 56 kbps or 64 kbps inverted (64 KI).

When all eight PCM bits in a channel are 0 and the eighth bit is not a signaling bit in state one, the seventh bit is substituted by a 1. This means zero code suppression is done on a per byte basis.

Note: Do not invoke the seventh bit substitution when digital data is being transmitted as this causes data corruption.

B8ZS coding

The B8ZS coding format supports 64 kbps clear channel (64 KC) or 64 kbps inverted HDLC (64 KI).

When eight consecutive 0s appear on a channel and the last bit transmitted is positive, the eight bits are substituted by the following pattern:

Substituted word 0 0 0 +1 -1 0 -1 +1

If the last bit was negative, the polarity is reversed. This results in the following substituted word:

Reverse polarity 0 0 0 -1 +1 0 +1 -1

Bipolar violations occur in the fourth and seventh bit positions of the inserted code. Therefore, B8ZS coding can be used only when the receiving end is capable of recognizing that these are not bipolar violations or bit errors.

Error detection

This section describes the ISDN error detection. There are four types of error detection:

- yellow (remote) alarm
- bit error rate
- frame alignment
- frame slip

Yellow alarm (remote alarm)

A yellow alarm signal (received by the near end) indicates that the far end (the remote end) is not ready. If the PRI is receiving the yellow alarm pattern, it indicates that there is a T1 connection. When the PRI receives a yellow alarm signal from the far end, all 24 channels are disabled.

The yellow alarm method used depends on the framing format (D2, D3, D4, or ESF) selected. If D2, D3, or D4 framing formats are chosen, Digit 2 yellow alarm is automatically selected by software. If the ESF framing format is chosen, the yellow alarm method must be set through service change.

- Digit 2 (DG2) yellow alarm signaling is provided by external circuitry. This alarm is detected when each digit 2 in 63 contiguous channels is logic zero. Use DG2 yellow alarm signaling with D2, D3, and D4 frame formats in Canada and the U.S. Also use DG2 yellow alarm signaling with the ESF frame format in Canada, in compliance with Canadian standard CS03.
- Facility Data Link (FDL) yellow alarm signaling is a 4 kbps channel. In the U.S., use FDL yellow alarm signaling when the ESF frame format is selected.

When the PRI stops receiving the yellow alarm, channels are placed into the idle state and made available for calls. (In comparison, TIE trunks using A&B bit signaling are made to match the state of the far end, as presented by the T1 port.)

Each time a yellow alarm is generated, a counter is incremented. When the remote alarm 24-hour threshold (prompt RALM in LD 73) is reached, the PRI must be restored to service manually.

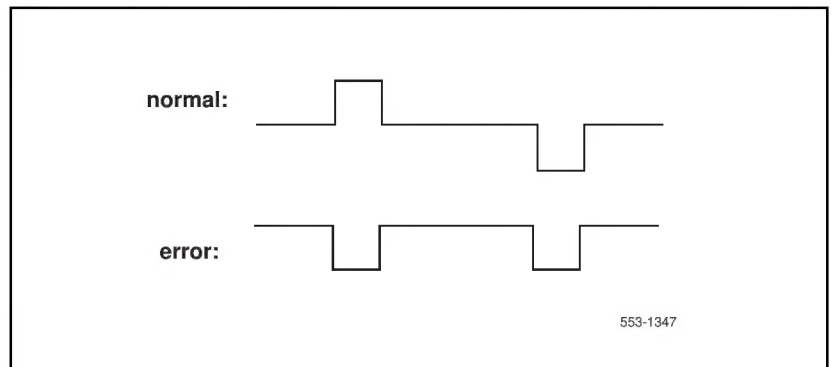
Bit error rate

Bit error rate monitoring detects errors in transmission. There are two methods of bit error rate monitoring: bipolar violation tracking and cyclic redundancy check (CRC). If the D2, D3, or D4 framing format is selected in LD 17, prompt DLOP, bipolar violation tracking is implemented. If the extended superframe format (ESF) is selected, CRC is implemented.

Bipolar violations (BPV) In a bipolar pulse stream, pulses alternate in polarity. A bipolar violation has occurred if, after transmission, two pulses of the same polarity are received in succession (this could be caused by an electrical disturbance, such as noise). See Figure 8.

Note: Some bipolar violations are normal when using the B8ZS coding.

Figure 8
Bipolar violations



Cyclic redundancy check (CRC) The extended superframe (ESF) format contains a checksum of all the data in the frame. The receiving side uses the checksum to verify that the data is correct.

The primary difference between BPV and CRC is that bipolar violations indicate errors on the local span, while CRC indicates errors on an end-to-end span. For example, on a satellite link, BPV only detects errors in the span between the Meridian 1 system and the satellite connection. Since CRC traverses the entire span, it detects errors from the Meridian 1 system to the satellite connection, then to the far end connection, indicating an end-to-end bit error rate.

Bit error rate thresholds PRI hardware detects BPV or CRC errors. It sends an overflow (OVFL) message to the Meridian 1 CPU each time 1024 BPV or CRC errors are detected. Running the midnight routines prints the number of overflows and clears the counter.

There are three bit error rate thresholds set in LD 73. Setting BIPC to zero enables automatic recovery.

BIPV	1–(3)–4	maintenance threshold
	1–(2)–4	out-of-service threshold
BIPC	0–(2)–128	maximum number of times a DTI/PRI loop can be taken out of service in 24 hours

Note: The BIPV values determine the sensitivity of the loop to errors, where BIPV = 1 is the least tolerant to errors, and BIPV = 4 is the most tolerant.

Frame alignment

Loss of frame alignment monitoring detects out-of-frame conditions on the DS-1 bit stream.

Loss of frame alignment thresholds PRI hardware detects out-of-frame conditions. Running the midnight routines prints the number of loss of frame alignment occurrences and clears the counters.

If a loss of frame alignment condition persists for 3 seconds, the affected PRI loop is taken out of service and a red alarm (local alarm) is raised. If the loss of frame alignment condition clears for at least 15 seconds, the PRI is automatically restored to service. Three frame alignment thresholds are set in LD 73. Setting LFAC to 0 enables automatic recovery.

LFAL	1–(17)–10240	maintenance threshold
	1–(511)–10240	out-of-service threshold
LFAC	0–(3)–128	24-hour out of service limit

Frame slip

Digital signals must have accurate clock synchronization for data to be interleaved into or extracted from the appropriate timeslot during multiplexing and demultiplexing operations. Frame slip monitoring detects frame deletion and repetition errors in clock synchronization.

Clock synchronization can either track on a primary or secondary reference clock, or operate in free run (nontracking) mode. In LD 73 (prompts PREF and SREF), one PRI can be defined as the primary clock reference. Another can be defined as the secondary clock reference.

Tracking mode

PRI hardware detects frame slips in a tracking reference clock. Running the midnight routines prints the number of overflows and clears the counters.

There are two thresholds set in LD 73.

SRTK	1–(5)–24	maintenance threshold (elapsed time in hours between frame slips)
	1–(30)–3600	out-of-service threshold (number of slips per hour)

Automatic recovery

After the tracking mode (SRTK) or nontracking mode (SRNT) out-of-service thresholds (the second value for these prompts) are exceeded, the slip rate is monitored for improvement. When the slip rate has improved, the trunks are returned to service.

There are two parameters set in LD 73:

SRIM	(1)–127	improvement timer in minutes
SRMM	1– (2)–127	improvement criteria

If the nontracking mode maintenance threshold (the first value for SRNT) does not exceed SRMM in the duration of SRIM, then the trunks are returned to service. If not, the timer is restarted and monitoring continues.

Frame slippage is considered less important than alarms for loss of frame alignment persisting for 3 seconds, remote alarm, and bipolar violations exceeding the out-of-service threshold. If any of these alarms are reported while the slip rate is being monitored for improvement, then the monitoring stops. The trunks are returned to service only when the more serious alarm clears.

Free run (nontracking) mode

PRI hardware detects frame slips in the free run mode. Running the midnight routines prints the number of frame deletions and repetitions and clears the counters.

Data rate parameters

ISDN uses three types of data rates 56 kbps inverted, 64 kbps clear, and 64 kbps restricted.

56 kbps inverted

A 56 kbps channel is specified with the Bearer Capability Information Element (IE).

- The information transfer capability is set to restricted digital information.
- The information rate is set to 56 kbps.
- The layer and protocol identification in octet 5 is set to user information layer 1 protocol, rate adaptation, and the rate is encoded as 56 kbps.

64 kbps clear and restricted

The 64 kbps restricted (inverted HDLC), or 64 kbps clear (64C) is specified in the Bearer Capability IE in the SETUP message.

The 64 kbps restricted switched connections are supported by the Meridian 1 to DMS-100 protocol.

The Meridian 1 to Meridian 1 protocol supports 64 kbps clear transmission.

Channel parameters

There are two types of ISDN channels B-channels and D-channels.

B-channels

To minimize glare situations, Meridian 1 allocates B-channels from channel 23 down to channel 1; DMS-100 begins at channel 1 and goes up to channel 23.

Set outgoing trunk hunting on B-channels for the round robin searching method, rather than the linear method. Thus, when the system looks for an outgoing idle trunk, it looks for the next lower available trunk member, rather than the last member that was used.

The B-channel network loop, 0–511, and the PRI channel number, 1–23, are defined in LD 14.

D-channels

The D-channel location must be coordinated with the far end. See the correlation tables in this guide for specific information.

To establish the PRI link, the D-channel interface port number and PRI loop numbers are associated in LD 17. The DCHI port number must be an odd number between 1 and 15. PRI loop numbers may be between 0 and 511.

The D-channel can operate at 56 or 64 kbps data rate. It can be 64 kbps clear, 64 kbps restricted (inverted HDLC), or 56 kbps. The selection of data rate is on a per PRI basis and is determined by service change. The B8ZS zero code suppression method is used to achieve 64 kbps clear channel for the D-channel.

For incoming PRI messages, the printout of the D-channel monitor message differs from the actual message received by the Meridian 1. This is due to the fact that layer 2 preprocesses the message before sending it to layer 3. Outgoing PRI messages appear exactly as sent.

Interface protocols

User-to-network

The interface protocol between Meridian 1 and central office (CO) PRI equipment is a user-to-network protocol. If the far end is identified as a CO in service change (LD 17), the Meridian 1 system is automatically designated as the “user.”

The user-to-network protocol does not employ the same call states and state transactions at each end, and does not always send the same response to a given protocol message. In addition, the user-to-network protocol has an implicit master-slave relationship, relinquishing control to the network in cases such as glare resolution.

Symmetric

The interface protocol between a Meridian 1 and another Meridian 1 is a symmetric protocol. Call processing uses a master-slave relationship for glare resolution.

One PBX must be designated as the network (master), the other as the user (slave) (in LD 17). If the master side of the interface sends a SETUP message as the slave initiates an outgoing call, priority is given to the call sent from the master switch. The outgoing call on that channel, the call initiated by the slave, is dropped and another virtual B-channel is selected for call origination.